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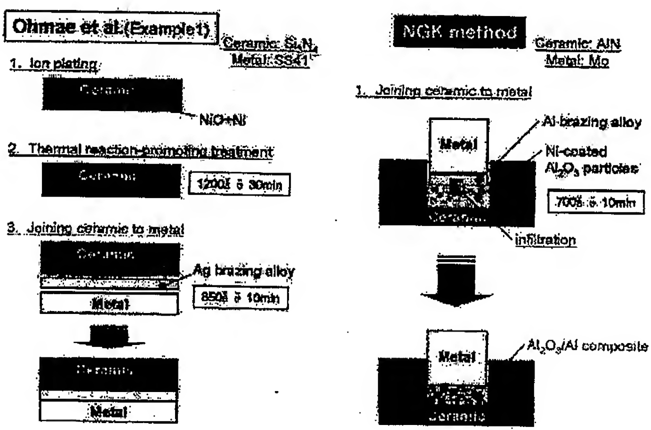
2. Claims 1, 2, and 5-8 were rejected under 35 U.S.C. 103(a) as unpatentable over Ohmae et al. (USPN 4,624,404) in view of Ushikoshi et al. (USPN 6,057,513). This rejection is traversed.

At the interview the Examiner was shown the following Comparative Chart.

Comparative Chart



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The present application is assigned to NGK so the right column is shown as the NGK method. Applicants' process is illustrated and is a <u>one step bonding process</u>, clearly distinguishing it from the Ohmae et al. '404 technique as emphasized at the interview. However, in terms of claim 1, the process is a <u>4-step forming process</u> as explained below:

1. First the particles are loaded in the dented portion;

2. Then the platy or powdery hard solder is disposed on top of the particles;

3. Next the protruded portion is inserted; and

4. Finally the structure in the <u>one-step bonding process</u> is heated either alone or under the application of pressure to bond the dented and protruding members through this fitting structure.

This species elected for examination is illustrated in Fig. 1, copied below:

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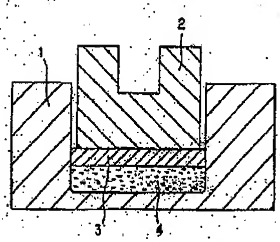
FIG. 1



The specification text at page 10, lines 12-27, describes the process discussed above.

An advantage of the claimed process is that one may easily lower the coefficient of thermal expansion of the composite layer by adjusting the filling ratio (or packing density) of the ceramic particles; see page 19, line 16, to page 20, line 10, of the specification.

Ohmae et al. '404, on the other hand, is directed to a completely different process. The reference does not teach the first step of applying particles into a dented portion. Nor does the reference teach applying platy or powdery hard solder onto the powder in the dented portion subsequently inserting the protruding member.

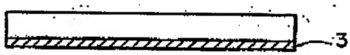
The final critical deficiency is that Ohmae et al. '404 fails to teach a final one-step bonding process. The bonding

that takes place in Ohmae et al. '404 is a three-step process that does not make use of dented and protruded fitting portions; the patent thus describes making a brazed product of a ceramic and metal layer by a process completely different from applicants' process.

Step 1:

Ohmae et al. '404 first makes a coating on a ceramic base with an insert material that is deposited on the ceramic layer 1 by

FIG. 1(b)



Top (1): Si_3N_4 or SiC ceramic

3: insert material such as NiO + Ni or Cu_2O + Cu

ion plating or spray coating as illustrated in Fig. 1(a), which is identical in appearance to Fig. 1(b) copied above; see the related description at col. 2, lines 42-55.

The insert materials are described at col. 2, lines 5-12, which includes a listing of various examples of the composite material.

Ion plating is used to make very thin coatings. Ion plating is used in Examples 1 and 3-6 of Ohmae et al. '404 and the

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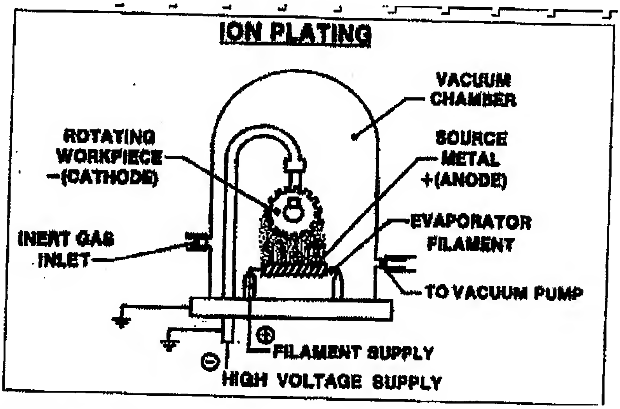
thickness varies from 20 µm to 30 µm. Ion plating is described more in the enclosed copy of a web page from Brigham Young University with the URL http://class.et.byu.edu/mfg130/processes/descriptions/surfacecoating/ionplating.htm. The enclosure is from a course Introduction to Modern Manufacturing (MFG 130) in the college of Engineering and Technology. An ion plating system is shown:



The web page states:

> In ion plating, a thin metallic coat is deposited on the workpiece. The workpiece (the cathode) and the source metal (the anode) are submitted to a vacuum chamber where a heat source causes the source material

to evaporate and form a vapor. This metallic vapor then condenses on the workpiece.

The process characteristic described on that web page means that ion plating can produce a uniform metallic deposit on complex tool geometries and that common metals and alloys are typically used. The disadvantages, however, are that ion plating is performed in a vacuum chamber using inert gas; ion plating transfers a metallic deposit via a metal vapor; ion plating requires very clean surfaces; and ion plating is a relatively expensive way to apply a desired metallic coating.

It is also not clear how a coating technique of this type will produce particles because the total thickness of the coating is from 20 µm to 30 µm. Applicants' powder in Example 1, in contrast, has a particle diameter of 47 µm; the thickness of the alumina power layer is 0.8 mm, substantially much larger than the maximum thickness of 30 µm of Ohmae et al. '404.

Step 2:

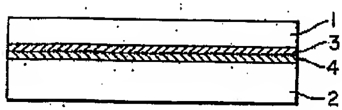
A thermal reaction-promoting treatment or processing is then given to the plating or coating as illustrated in Fig. 1(b) and described in col. 2, lines 55-57. In Example 1 thermal treatment is carried out at a temperature of 1200°C for 30

minutes (col. 7, lines 53-54) to increase the bonding strength between the ion-plated insert material and the ceramic. The purpose of this required treatment is found in col. 2, lines 16-18, which informs the reader that "strong bonding is ensured by the thermal reaction-promoting treatment or processing." Such a thermal reaction-promoting treatment or processing is not used in applicants' process.

Step 3

In the Ohmae et al. '404 final step, a metal plate made of stainless steel is laid over the Ni/NiO composite member, and an Ag brazing material having a melting temperature lower than that of the insert material is provided in the space between the insert and metal member. The resultant product is then heated to a temperature of 850 °C for 10 minutes, and the insert and the metal member are bonded as illustrated in Fig. 1(c), copied below.

FIG. 1(c)



1:	ceramic layer
3:	insert material
4:	brazing or soldering material
2:	metal layer

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The Ohmae et al. '404 process does not appear to cause any fine particles to be present when the ceramic and metal layers are being bonded because any "fine particles" in the deposited insert layer may well have been melted and uniformly bonded to the ceramic during the thermal reaction-promoting treatment or processing.

The Ohmae et al. '404 embodiment where ceramic particles are in-situ formed by subjecting Ni to an oxidation or nitrification during the ion-plating step results in a limited volume of the formed ceramic particles. Thus, the artisan may not lower the coefficient of the thermal expansion to any great extent, as in the present process. Indeed, the lowering of the residual stress in the ceramic/metal bonded member is also limited.

On the other hand, in the case of the present invention, as explained previously, one may <u>easily lower the coefficient of the thermal expansion</u> of the composite material layer by just adjusting the filling ratio of the ceramic particles. Thus, the present method is quite evidently entirely different from the one disclosed by Ohmae et al. '404.

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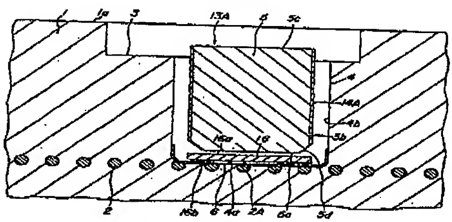
The Examiner notes Ohmae et al. '404 does not teach a method for bonding ceramics and metals including a member having a <u>dented portion</u> and a member having a <u>protruded portion</u>.

Ushikoshi et al. '513 is cited to show that an artisan would be aware of bonding a ceramic member having a dented portion and a metallic member having a protruded portion with an electrically conductive member (brazing material) disposed between them. The structure before bonding in that reference is illustrated below - reproduced Fig. 3.

FIG. 3



The U-shaped ceramic material is 1, the metallic member is 5, the brazing material is 16, and the metallic foil is 6 (col. 3, lines 33-37). The invention of the reference involves using a coating layer 14a (col. 4, lines 27-32) along the sides of the metallic member to prevent the brazing material when molten from creeping up the sides of the metallic member. In col. 4, lines

29-30, the material 16 is described as "the electrically conductive joint material 16 such as brazing material or the like."

In the loading of temperature differences, such as in thermal cycle testing, for a bonded body, the Ushikoshi et al. '513 technique can not reduce the risk of cracks in ceramics or the interface of ceramics/hard solder caused by thermal stress induced by the CTE differences, due to the use of the material as an additive for the solder brazing material; see col. 7, lines 19 to 61. The presently claimed invention, on the other hand, achieves a reduction of the risk because of the low CTE of the solder; see page 6, line 7 to page 8, line 11 of the specification.

There is no proper suggestion or motivation to combine these two references because Ohmae et al. '404 relates to bonding flat layers where an initial thermal treatment is carried out on the insert material coated on the ceramic layer before the metal layer is bonded. Ushikoshi et al. '513 uses a one-shot process where the brazing material 16 and the metal foil 6 melt at the same time to fuse the ceramic material 1 to the metallic member 5.

According, review and withdrawal of this rejection are requested.

3. Claim 9 was rejected under 35 U.S.C. 103(a) as unpatentable over Ohmae et al. '404 in view of Ushikoshi et al. '513 as applied to claim 1 above, and further in view of Makino et al. (USPN 6,390,354). This rejection is traversed.

Claim 9 relates to the method of claim 1 where the fine particle material is formed of ceramic fine particles having their surface coated with a metal by plating or sputtering.

As discussed above in Section 2, the basic method of claim 1 is not taught or suggested by the two primary references.

Makino et al. '354 and the present case have a common inventor, Masayuki Shinkai. The Examiner notes Makino et al. '354 constitutes prior art only under 35 U.S.C. 102(e). The Examiner also notes:

> For applications filed on or after November 29, 1999, this rejection might also be overcome by showing that the subject matter of the reference and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person. See MPEP § 706.02(l)(1) and § 706.02(l)(2).

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Both Makino et al. (USPN 6,390,354) and the parent of this divisional application, now USPN 6,348,273, are commonly assigned to NGK Insulators, Ltd as noted on each of the patents. Because this divisional application was filed after November 29, 1999, under the provision quoted above by the Examiner, Makino et al. '354 is not prior art here because of common ownership.

Accordingly, review and withdrawal of this rejection are requested.

4. Claims 1, 3, and 5-8 are rejected under 35 U.S.C. 103(a) as unpatentable over Ohmae et al. '404 in view of Do-Thoi et al. (USPN 5,525,432). This rejection is traversed.

Claim 3 is directed to a second embodiment illustrated in Fig. 2 where the protruding portion has one or more holes for insertion of the hard solder.

Ohmae et al. '404 is detailedly discussed in Section 2 above. In the reference technique, fine particles are not present when the ceramic and metal layers are being bonded because the fine particles in the deposited insert layer are melted and uniformly bonded to the ceramic during the thermal reaction-promoting treatment or processing.

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The Examiner also notes that Ohmae et al. '404 does not teach a method for bonding ceramics and metals including a member having a dented portion and a member having a protruded portion.

Do-Thoi et al. '432 relates to internal soldering in metal/ceramic composites. Fig. 1 of that reference is reproduced below.

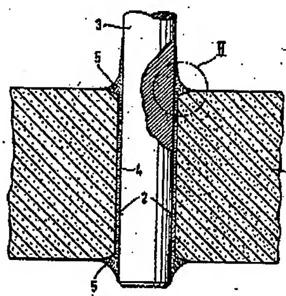

Fig. 1

Contrary to the statements made in the Office Action, it appears that ceramic member 1 has the "dented" portion with hole 2 while metal pin 3 is the "protruded" portion which fits into that hole. The passages in col. 3, lines 10-15, and col. 4, lines 20-25, inform one that the metal pin is coated with a solder material and inserted in the hole 2 and the assembly is heated

to melt the solder and join the metal pin and the ceramic material 1.

Do-Thoi et al. '432 does not teach having the protruding pin portion with at least one hole where the hard solder is inserted. The patent also does not teach having the dented ceramic layer portion with a layer of fine particles before the bonding step.

Accordingly, review and withdrawal of this rejection are requested.

5. Claim 9 was rejected under 35 U.S.C. 103(a) as unpatentable over Ohmae et al. '404 in view of Do-Thai et al. '432 as applied to claim 1 above, and further in view of Makino et al. '354. This rejection is traversed.

The deficiencies of the combination of the two primary references are discussed above in Section 4.

Makino et al. '354 was discussed in Section 3. Makino et al. '354 is not de jure prior art here in a Section 103(a) rejection.

Accordingly, review and withdrawal of this rejection are requested.

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6. Claims 1 and 4-9 were rejected under 35 U.S.C. 103(a) as obvious over Ushikashi et al. '513 in view of Makino et al. '354. This rejection is traversed.

Claim 4 is directed to the third embodiment of the invention illustrated in Fig. 3.

The Examiner admits Ushikoshi et al. '513 does not teach a method including a step of previously preparing a member having a protruded portion, the end of which has a layer comprising a hard solder and a fine particle material, wherein the fine particle material reduces thermal stress and is ceramic, cermet, low-expansion metal fine particles, or ceramic fine particles coated with a metal by plating or sputtering.

Makino et al. '354 is cited to teach this concept. The reference, for the reasons given above, is not de jure prior art.

Accordingly, review and withdrawal of this rejection are requested.

Applicants respectfully submit that the present application is now in condition for allowance. Accordingly, the Examiner is requested to issue a Notice of Allowance for all pending claims.

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Should the Examiner deem that any further action by the applicants would be desirable for placing this application in even better condition for issue, he is requested to telephone applicants' undersigned representative at the number listed below.

Respectfully submitted,

PARKHURST & WENDEL, L.L.P.

December 29, 2003
Date

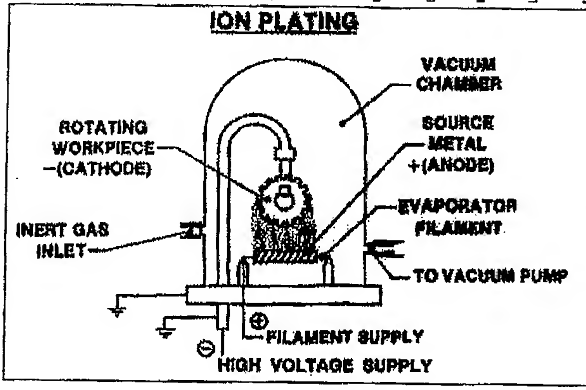
Charles A. Wendel
Registration No. 24,453

CAW/EC/klb
Enclosure:
Web page from Brigham Young University
http://class.et.byu.edu/mfg130/processes/descriptions/surfacecoating/ionplating.htm

Attorney Docket No.: WATK:193A

PARKHURST & WENDEL, L.L.P.
1421 Prince Street, Suite 210
Alexandria, Virginia 22314-2805
Telephone: (703) 739-0220

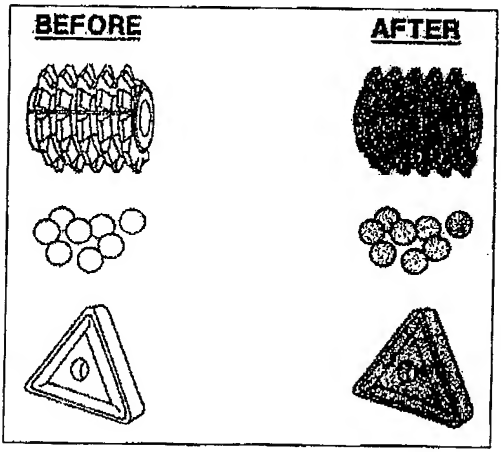
Ion Plating



In ion plating, a thin metallic coat is deposited on the workpiece. The workpiece (the cathode) and the source metal (the anode) are submitted to a vacuum chamber where a heat source causes the source material to evaporate and form a vapor. This metallic vapor then condenses on the workpiece.

Process Characteristics

- Is performed in a vacuum chamber using inert gas
- Can produce a uniform metallic deposit on complex tool geometries
- Transfers a metallic deposit via a metal vapor
- Typically utilizes common metals and alloys
- Requires very clean surfaces
- Is a relatively expensive way to apply a desired metallic coating



BACK

Information provided is from Manufacturing Processes Reference Guide by Robert H. Todd, Dell K. Allen, and Leo Alting.--1st ed. Published by Industrial Press Inc., 1994.